Inorganic carbon and nitrogen assimilation in cellular compartments of a benthic kleptoplastic foraminifer

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Résumé en anglais

Haynesina germanica, an ubiquitous benthic foraminifer in intertidal mudflats, has the remarkable ability to isolate, sequester, and use chloroplasts from microalgae. The photosynthetic functionality of these kleptoplasts has been demonstrated by measuring photosystem II quantum efficiency and O2 production rates, but the precise role of the kleptoplasts in foraminiferal metabolism is poorly understood. Thus, the mechanism and dynamics of C and N assimilation and translocation from the kleptoplasts to the foraminiferal host requires study. The objective of this study was to investigate, using correlated TEM and NanoSIMS imaging, the assimilation of inorganic C and N (here ammonium, NH4+) in individuals of a kleptoplastic benthic foraminiferal species. H. germanica specimens were incubated for 20 h in artificial seawater enriched with H13CO3− and 15NH4+ during a light/dark cycle. All specimens (n = 12) incorporated 13C into their endoplasm stored primarily in the form of lipid droplets. A control incubation in darkness resulted in no 13C-uptake, strongly suggesting that photosynthesis is the process dominating inorganic C assimilation. Ammonium assimilation was observed both with and without light, with diffuse 15N-enrichment throughout the cytoplasm and distinct 15N-hotspots in fibrillar vesicles, electron-opaque bodies, tubulin paracrystals, bacterial associates, and, rarely and at moderate levels, in kleptoplasts. The latter observation might indicate that the kleptoplasts are involved in N assimilation. However, the higher N assimilation observed in the foraminiferal endoplasm incubated without light suggests that another cytoplasmic pathway is dominant, at least in darkness. This study clearly shows the advantage provided by the kleptoplasts as an additional source of carbon and provides observations of ammonium uptake by the foraminiferal cell.

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